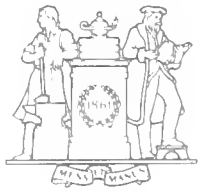

MASSACHUSETTS INSTITUTE of TECHNOLOGY
LIBRARIES



# IMPROVING SYSTEMS DELIVERY: A MANAGERIAL PERSPECTIVE

John F. Rockart
J. Debra Hofman

June 1991
(Revised May 1992)

CISR WP No. 223
Sloan WP No. 3320

Center for Information Systems Research
Massachusetts Institute of Technology
Sloan School of Management
77 Massachusetts Avenue
Cambridge, Massachusetts, 02139

# IMPROVING SYSTEMS DELIVERY: A MANAGERIAL PERSPECTIVE

John F. Rockart
J. Debra Hofman

June 1991
(Revised May 1992)

CISR WP No. 223
Sloan WP No. 3320



Forthcoming in the *Sloan Management Review*.



**Center for Information Systems Research**
Sloan School of Management
Massachusetts Institute of Technology

# IMPROVING SYSTEMS DELIVERY: A MANAGERIAL PERSPECTIVE

**John F. Rockart and J. Debra Hofman**

*ABSTRACT*

In order to improve their capability to deliver information systems more quickly, inexpensively, and effectively, many organizations today are considering major investments in new systems development tools, methods, and techniques. Many are struggling with the decision of whether to invest in CASE tools, other types of tools and methods, software packages or nothing at all. The decision, however, is not an easy one. Based on conversations with senior managers in twelve companies, a framework emerges which can be used to address the many issues which are involved. Rethinking and investing in a redesigned systems development process is critical and must be anchored in the business context. The associated issues are major, strategic in nature, and require significant senior management attention.

Acknowledgements: We would like to thank the managers we interviewed for their time and their insights into these important issues. We would also like to express our appreciation to Christine Bullen, John Henderson, Chris Kemerer, Benn Konsynski, Wanda Orlikowski, Judith Quillard, Elise Rockart, and James Short for their comments on this paper, to Deb Small for her support, and to the sponsors of CISR's Systems Delivery Research Program -- Ernst & Young, IBM Corporation, and Texas Instruments, Inc. -- for their support.

# IMPROVING SYSTEMS DELIVERY: A MANAGERIAL PERSPECTIVE

*Scene: The office of the manager of a strategic business unit in a major corporation.*

***Vice President of Information Systems:*** *"We just have to build systems faster, better, at lower cost, and in a way that they are easier to maintain and change. That's the reason we're going to bring in CASE technology."*

***SBU Manager:*** *"I'm told that's expensive to do and involves major change in your organization. We ought not to be building systems at all! There are good "packages" on the market today. Let's use them -- it's cheaper and faster -- and we know you can install them. We saw you do it over in accounting."*

## INTRODUCTION

Variations on the conversation described above can be heard today in many organizations. In an era of cost-cutting and flat budgets, many chief information officers (CIOs) are requesting significant dollar outlays to radically change the ways in which systems are developed and to make the information systems (IS) organization more productive. In some cases, the IS managers want to buy computer aided software engineering (CASE) tools that help to automate the process of developing systems; in others, they want to introduce an "object-oriented" approach;[1] in still others, they are bringing in new development methods in combination with the above.

At the same time, others in the organization are challenging the wisdom of the investment that this would require. For many, the benefits to be achieved from an

---

[1] Object-oriented systems development is a relative newcomer to the world of business systems, and represents a different approach to developing systems -- both in terms of methodology and the tools required to support it -- than its predecessors. Where a traditional system is composed of programs that define procedures and use data, an object-oriented system is composed of self-contained objects, containing both procedures and data, that send messages to each other.

investment in the process of developing systems are unclear. Year after year, they have witnessed constant increases in IS expenditures. They have been through myriad "waves of the future" and "silver bullets": fourth-generation languages, data-centered design, expert systems, prototyping, relational technology, and others. Still, there is a software bottleneck. For many companies, information systems are not only *on* the critical path to getting a new product or service to market, they are *the* stumbling block on that path.

Suggestions by the IS organization to improve the situation, however, are meeting with some skepticism today. Rather than invest large sums in new IS development methods, many business managers propose an alternative that they believe will be faster and cheaper -- buy packages. Instead of building the needed information systems internally and continually investing in rapidly changing new methodologies, tools, or techniques, they propose to purchase off-the-shelf software packages wherever possible.

Which approach is correct? The answer is far more complex than the choice of the tools alone. Any decision about IS tools, methods, and approaches -- whether CASE, fourth-generation languages, object-oriented development, or software packages -- must be anchored in the context of the company's future business environment and the systems environment that will be needed to support this business scenario. Only then can the discussion about IS tools and methods realistically begin. Moreover, the decision ultimately is not a question of CASE tools *or* packages *or* prototyping *or* fourth-generation languages. Rather, it is about choosing a portfolio of approaches or delivery mechanisms that will allow the fulfillment of the organization's business vision.

Moving to new systems development technologies requires considerable time and thought on the part of both line and IS managers and involves a major investment of dollars and other resources. In fact, it is a prime example of "business process redesign" [Hammer, 1990; Davenport & Short, 1990] for it involves extensively reworking the way in which the fundamental process in the information systems function -- the process of systems

development -- is carried out. The decision is major, and requires significant senior management attention.

The conclusions about improving the systems delivery process presented here arose from discussions with senior managers in twelve companies that are leaders in the use and management of information technology. All twelve companies were aggressively implementing new approaches to systems development. The companies ranged in size from $500 million to $30 billion, and industries included finance, insurance, manufacturing, petroleum, chemical, and computers. Interviewees typically included the senior IS executive and three to five managers reporting to him or her. In some cases, we interviewed senior line managers as well. Each discussion generally lasted from one to two hours.

Significantly, these twelve companies were in the minority in terms of their level of involvement with new tools and approaches. The majority of companies we contacted in the search for appropriate study sites were either just experimenting with new tools on a small scale or continuing with the old tools and approaches. Although senior IS managers, and sometimes even line managers, were clearly aware of the *need* to improve systems development, the funding had not been committed. The reasons included budget constraints, the perceived high cost of investment in appropriate hardware and software, and doubt about the capabilities of available development tools.

In contrast, our study sites were convinced that they had to improve systems development and were aggressively investing to do so. Although there were distinct differences in the approaches of these companies, a pattern emerged as shown in Figure 1. This framework will be used to highlight the similarities as well as the differences among these companies. The framework describes a two-phase process. In the first, or *envisioning* phase, management either implicitly or explicitly considered three future "environments" for the business. These are as follows:

- the projected business environment -- a vision of the future business organization and the way in which the organization must operate to be effective in the market(s) that it serves;
- the projected systems environment -- a strategic vision of the systems environment that will enable the business vision (an IS version of an articulated "strategic intent" [Hamel and Prahalad, 1989])(See also Henderson and Venkatraman, 1990.); and
- the projected development environment[2] -- the *portfolio of delivery mechanisms* (including tools, methods, and approaches) that will enable the delivery of systems to meet the needs of the projected systems environment.

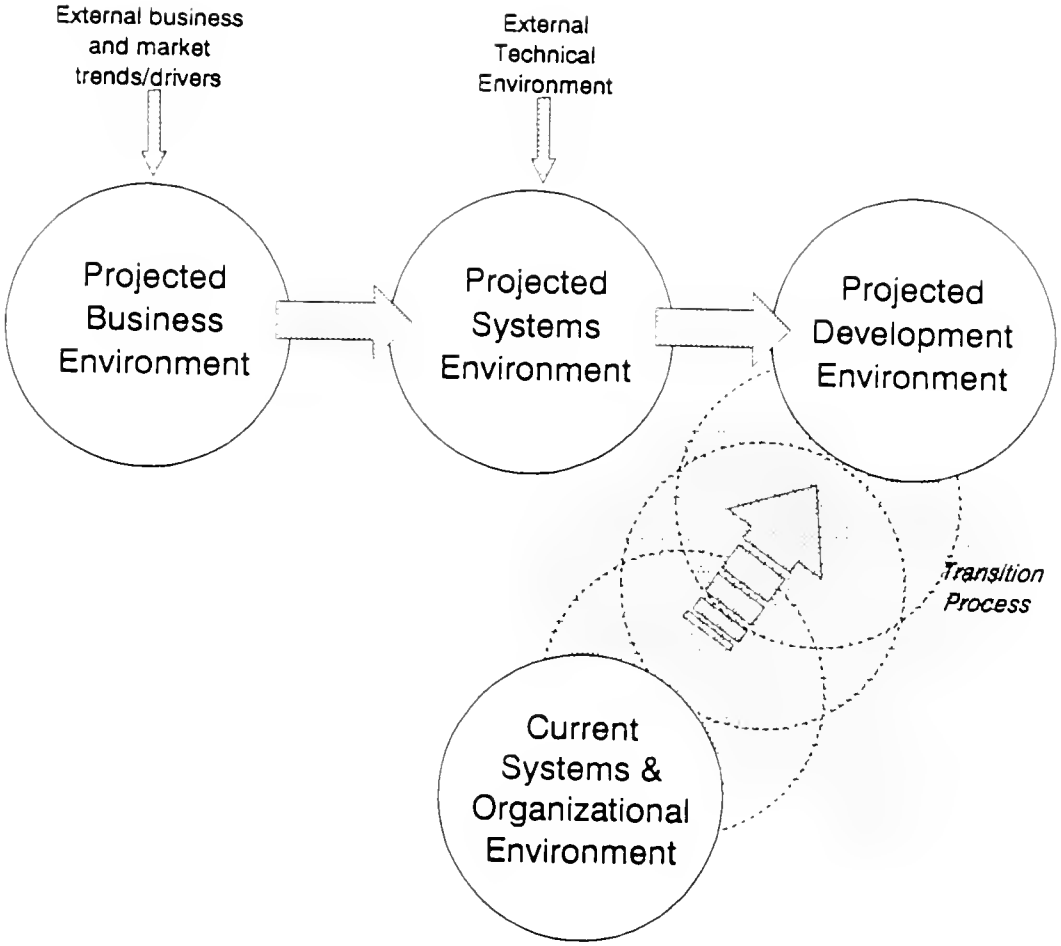
The second phase encompassed the transition from the current environment to the projected development environment. Action plans for this phase included the selection of specific tools and methods to be installed in the short and medium term to migrate toward the projected development environment, taking into account both enabling and constraining factors in the current environment.

The four environments depicted in the framework are directly related: the outcome of one either drives or is affected by the next. Figure 1 highlights the fact that the decision regarding specific IS tools and methods -- the transition phase -- was made only after careful consideration of the environments noted in Phase 1.[3]

---

[2] In this context, "development environment" refers to the full solution set by which the required information systems will be delivered to the organization in the future -- the portfolio of types of tools, methods, techniques, database structure, approaches, and so on. An "approach" might include, for example, the use of off-the-shelf software packages to deliver systems solutions whenever possible or a decision to outsource data center operations. While the projected systems environment defines "what," the projected development environment defines "how."

[3] We recognize the reciprocal nature of the interaction among these components. That is, while the projected business environment shaped the choices in the projected systems environment, the projected systems environment in turn shaped the projected business environment. And, while the projected systems environment shaped the projected development environment, the reverse was clearly true here as well. The strategic planning underlying the decisions made in the projected business and systems environment is a complex and highly interactive process. However, for the purpose of clarity, we focus here on the one direction described above and depicted in Figure 1.




**Improving Systems Delivery:**
**The Managerial Perspective Framework**

*Figure 1*

In the following, we will discuss this process and the actions of these companies in greater detail. Three of the twelve companies will be used as representative examples throughout this discussion. The first company is a major provider of property and casualty as well as life insurance products. The second company is a Fortune 100, multinational, chemical firm. The third company is a multinational energy company.

## PHASE 1: ENVISIONING THE FUTURE ENVIRONMENT

In describing the process by which choices are made about current and future IS development tools, the people we interviewed repeatedly noted each of the four environments in the framework, in part or in total. In this section, we describe Phase 1 of the framework -- the three-step process of envisioning the future development environment. The scenarios for the first three environments, as developed by most of the IS directors with whom we spoke, were surprisingly similar. Although the industries were different, the conditions and resulting requirements that were described were much the same.

### The Projected Business Environment

The three representative companies described their future business environments as follows:

- ***The Insurance Company.*** *The insurance provider described the demand for new products as "frenetic." Insurance products themselves are becoming commodities, and service quality is fast becoming the competitive differentiator. The introduction of new products is necessary just to stay in the game, and new products are developed almost daily.*

- ***The Chemical Firm.*** *For most of its history, this firm had been organized by product. Each of the approximately thirty divisions was relatively autonomous, subject only to a minimum of central direction in financial and personnel matters. Where scale was an issue, certain corporate functions (e.g., the management of data centers) were centralized.*

*The advent of a new CEO three years ago is changing this. Citing the need for globalization, a customer emphasis, and empowerment through information at all levels in the organization, as well as other factors, the CEO is steadily integrating the parts of the organization. He is also imbuing a team-oriented philosophy and reorganizing around customer segments.*

- ***The Energy Company.*** *In 1987, one of the company's divisions conducted a strategic review of its information systems needs and capabilities. Management realized that integration across subunits in the company had become very important -- that, for example, what happened in the refinery was integrally tied to operations in the service stations. Lack of integration was hurting performance, both in terms of customer service and the financial results. Management also recognized that change in the industry had become the norm, and that access to accurate, timely, and consistent information had become critical to running the business.*

Although each company is in a different industry and has specific issues that apply to that industry, there is a centrality to the trends that were noted. All of the companies noted that the pace of change has quickened considerably and promises to continue. For almost all, competition has both increased dramatically and expanded into the global arena. Time has become a critical competitive differentiator: time to market for new products, manufacturing cycle time for existing products, and timeliness of decision making, all previously important, are now critical. The focus is now on the customer and on quality as perceived by the customer.

Companies are taking three major actions to respond to these trends, all of which involve significant changes in the way they are being operated and structured. First, companies are realigning along "business process" lines [Davenport & Short, 1990; Hammer, 1990] in order to serve customers faster and with better quality. Second, many organizations are either physically combining or managerially restructuring formerly independent business units in order to reduce cost and improve customer service. Increasingly, the parts of the organization (functions, strategic business units, divisions, etc.) are seen as *interdependent* rather than independent [Rockart & Short, 1989]. Finally, firms are both decreasing the number of employees and "empowering" these employees with the information needed to

carry out their tasks. Flatter and leaner, but information rich, organizations are beginning to emerge in order to reduce costs, speed decision making, and serve customers.

The longer-term outlook is less clear. However, most executives agree on one major perspective on the future. It will be a future in which *ongoing change*, both external and internal, will have to be reacted to *continually*.

**The Projected Systems Environment**

The projected systems environment, as related to us, was based on the envisioned business environment. Although each organization faced a different industry and internal environment, the projected systems environments had much in common. A brief look at some aspects of our three example companies provides some insights:

- ***The Insurance Company.*** *This company is faced with a mismatch between its information systems environment and its business environment. Currently, each new product requires the development of a completely new system. The sooner the system is developed, the sooner the company can realize the added revenue from the product. One manager described the business this way: "What we do here is talk [sell] all day, and code all night." In the most fundamental way, the development of each system is now on the critical path of new product development. This company, therefore, has decided that it must be able to develop high-quality systems quickly. As such, it has outlined a technology vision of using flexible, modular systems that can be easily customized for each new product.*

- ***The Chemical Firm.*** *Based on the need for globalization, integration, a customer and team orientation, and common business processes, this firm recognizes that information must be easily accessible for empowered employees. In addition, transaction systems will need to be flexible and integrated, to transcend traditional boundaries, and to support common business practices.*

- ***The Energy Company.*** *Senior managers in this company realized they had a widely diverse set of technologies (hardware and software) and redundant, unreliable, and difficult-to-access data. They envisioned: 1) an enterprisewide system comprising horizontally-integrated subsystems that could be changed to respond quickly to external changes and 2) a shared corporate data environment*

*-- an information architecture -- that would provide consistent and timely information to its users.*

The differences described above were dominated by the underlying similarities of the ultimate systems environment as proposed by our study sites. All organizations expressed a need for high quality, flexible systems that can be changed quickly to meet rapidly evolving business needs. These systems should be easily transportable from one part of the global organization to another -- perhaps cloning the fundamental logic to reflect business practices that need to be the same but allowing for quick and easy tailoring of some portions of each system to reflect local differences. Finally, all noted the need for a flexible technological environment in which new technologies can be introduced as they become available without major disruption to the existing technology foundation.

Not only will the *characteristics* of the systems environment be different than in the past, but the *types of systems* that will be supported by this environment will be different as well. For organizations with the above technological vision, the information systems of the past no longer suffice. Most of these systems, which we will refer to as **transaction systems (TS)**, were primarily developed to process the operational paperwork of the firm. Built in the 1960s, 70s, and 80s, they reflected the organizations of their times: they were stand-alone, function-specific systems that processed transactions for tasks such as payroll processing, general ledger, and material requirements planning. Many of these systems drew upon, processed, and produced their own localized data.

The kinds of information systems which are needed to support the process-oriented, interdependent, and information-rich organization of today are vastly different. The organization that works across functional (and sometimes divisional) boundaries needs supporting cross-functional transaction systems, where the focus is on satisfying end-to-end business events or service strategies rather than discrete activities. Increasingly, these systems must span not only the value chain but also multiple business units. For example, the order entry system of the past must become the order logistics management system of

the future, managing and tracking each order through its life cycle across the functions of purchasing, inventory management, manufacturing, accounting, and distribution.

With regard to these transaction systems, two implications are clear. First, new systems development, long overwhelmed by maintenance of existing systems, will be necessary if process-oriented systems are to be created. The investment will be major. Second, not only the *nature* of the systems has changed, the *speed* with which they are needed and, more important, with which they must be *changed* has increased as well.

At the same time, the information systems needs of the organization are no longer limited to the realm of transaction systems. A world of plentiful data, text, and images in which timely decisions are critical requires systems that allow people at all organizational levels to easily access, manipulate, and analyze vast amounts of information. As such, decision support systems, executive support systems, spreadsheets, and end-user computing of all types are becoming increasingly integral components of the IS portfolio. We refer to this class of systems as **information support systems (ISS).** In the past, there has been less emphasis on developing these systems than on developing TS. However, the business environment noted above has shifted the priorities toward ISS and the firm's information architecture.

Clearly, there has been a dramatic change in the types of systems that the IS organization must deliver. We have discussed here two major classes of systems: TS and ISS. A company may have additional classes that are unique to its business operations; for example, an energy company has geological systems. The key is that *different development strategies are necessary for the different classes of systems.*

**The Projected Development Environment**

Our company examples described their projected development environments as follows:

- ***The Insurance Company.*** *Based on its vision of flexible, modular, easily customizable systems, the insurance company projected a development environment that will include systems assembled (rather than developed) from standardized components residing in an integrated CASE environment. Some components will be built internally; others will be purchased externally. At some point, users might themselves assemble and reassemble these components.*

- ***The Chemical Firm.*** *This firm's most significant current need is companywide access to consistent, reliable information. As such, the company is emphasizing systems, databases, and software that gather, store, and provide access to information to those who need it; transaction systems are currently taking a back seat. This firm's projected development environment will focus on tools and methods that will support the need for companywide access to consistent, reliable information and for software reuse in the development of transaction systems using both software packages and CASE tools.*

- ***The Energy Company.*** *This company envisions an integrated CASE tool environment that will support development efforts, help create integrated systems, and provide a common repository from which to manage information resources. A user information environment would also be established with tools to allow users with a wide variety of skills and capabilities to easily access, understand, analyze, and communicate information.*

Certain underlying similarities were apparent here as well. The future development environment, as perceived by most of the IS executives we interviewed, will be composed of the following:

- An integrated toolset[4] that facilitates the reuse of systems modules within a repository and an associated standardized methodology to deliver and maintain the transaction class of systems. The modules may be built internally or purchased in the form of packages, CASE-based templates, objects, and so on.

---

[4] We use the term "integrated toolset" to refer generically to any set of CASE tools that are logically and structurally interconnected. Currently, this integration can be accomplished in two ways. An organization may purchase various tools from different vendors that support the different phases of the systems development life cycle (i.e., design tools, code generators, etc.) and custom build the bridges between them. Alternatively, there are CASE tools, commonly referred to as I-CASE, which can be purchased with the integration or connections already built in. Please note that CASE tools are continually evolving -- when we refer to "CASE," we are *not* referring only to the current incarnation of these tools.

- Flexible, robust access tools for the information support class of systems.

- Companywide subject and information databases that connect the two classes of systems, that is, detailed data organized around "subjects" for the TSs, which then feed the information databases for the ISSs.

This development environment is very different from what most companies have today. Given the dramatic change in *what* the IS department must deliver to the organization, it is not surprising that *how* it is delivered must be changed dramatically as well. In the development environment of yesterday, the IS department responded separately to requests from each department. Accounting requested its general ledger and accounts receivable and payable systems. Manufacturing requested its scheduling and inventory systems. The personnel department requested its benefits and payroll systems. Moreover, in a company organized by product line, it was common for divisional manufacturing departments to request separate inventory systems.

But as described earlier, organizations are changing. Given a *process* focus, departments and sub-units are no longer independent, but interdependent. If the product development process is to be optimized, research and development, engineering, and manufacturing cannot remain completely independent anymore -- they must be coordinated and play their parts in the larger process. The new organization is not simply a remake of the old one with connections between its subunits; it is a reengineered entity that is now *coordinated* rather than simply *connected.* In the same way, the new systems development environment is not simply one in which bridges are built between previously unconnected systems; it is now one in which the relations and interconnections between systems are articulated and well understood before they are built so that *coordinated systems*[5] can be developed, where each system is one component within an integrated framework.

---

[5] In an environment such as this, for example, the design of one system would include the capture of information that could be used by other component systems downstream.

In such a development environment, the creation and update of data by each system is structured and managed. Portions of one system's design can be used in another. Systems are portable across hardware platforms, and parts are interchangeable: any element can be replaced without affecting business operations. The development process is well defined, flexible, and repeatable, so that measures of the quality, effectiveness, and productivity of the process and its resulting systems can be easily captured and effectively utilized [Kemerer, 1990]. In summary, this is a structured, integrated environment in which systems are *engineered* rather than built ad hoc. And it is this engineered characteristic that will eventually allow the component systems to be delivered quickly and changed easily.

New *types* of methods, tools, and approaches will be needed in order to provide this desired development environment. As discussed earlier, there is a *portfolio of solutions*, where different approaches may be appropriate for the different classes of systems needed. In the previous discussion, we drew a distinction between two major classes of systems: transaction systems and information support systems. The connection between the two classes of systems is the *data* they must share.[6] Tools and methods are needed to support each of the three major components: TS, ISS, and data. For the TS environment, there must be tools that will support the systems developers, tools that will allow the coordination and integration described above and that will result in structured systems that are easy to change. For the ISS environment, there must be tools that will allow the end user to easily access and understand data from multiple sources and to manipulate and analyze it as needed. Finally, there must be data management tools that will allow the structuring of the data, will insure its integrity, and will provide capabilities to migrate pertinent data into information data bases.

---

[6] That is, in addition to external information, information support systems must use data that is generated internally by the transaction systems. Today, this data is scattered throughout the organization in different forms, and much of it is relatively inaccessible, redundant, and costly to utilize.

Where do purchased software packages fit in an environment in which integration, coordination, and flexibility are key? First, off-the-shelf packages[7] that cannot easily be customized may be appropriate for business practices that do not need a lot of flexibility, such as certain areas of accounting and human resources. Second, a new breed of packages is now appearing -- software packages built using CASE tool -- that can be more easily changed and more easily coordinated with the rest of the organization's IS portfolio.

We have now reached the end of the first phase of the framework (Figure 1). We have described the way in which our companies envision the three future environments. Given the expected *interdependent change-oriented business environment*, and the expected *integrated systems environment* necessary to support this business environment, the shape of the necessary future *coordinated development environment* is reasonably clear -- as discussed above. Many IS organizations are already moving toward this development environment but in diverse ways.

**The Company Examples Summarized -- Phase 1**

It would be useful at this point to summarize the three company examples in terms of the first three environments we have just discussed. Although each organization is different, each to one degree or another considered all three steps leading to the determination of a future development environment. In addition, the companies used similar definitions not only of the major attributes of their business environments but also of the attributes of their projected systems and development environments.

- *At the major insurance provider, the current and projected business environment is "frenetic" -- new products must be delivered and current products adjusted daily to meet the changing demands of the marketplace. Service quality will be the competitive differentiator. The projected systems environment accommodates this*

[7] We are specifically referring here to those off-the-shelf software packages that cannot be easily customized through changes to the code by the organization purchasing them.

*need for speed and quality and is composed of flexible, modular systems that can be easily customized for each new product. The projected development environment is a structured one in which systems will be assembled (rather than developed) from predescribed, standardized components that are either built internally or purchased.*

- *Globalization, integration, a customer- and team-orientation and -- most important -- common business processes across geographical and product boundaries constitute the chemical firm's projected business environment. In the projected systems environment, information is accessible to empowered employees. Transaction systems are flexible and integrated; they span traditional divisional boundaries and support common business practices. The projected development environment focuses on tools and methods that will support the need for (1) software reuse in the development of transaction systems and (2) companywide access to consistent, reliable information.*

- *The energy company recognizes that its projected business environment is one in which 1) integration across subunits has become very important, 2) change is the norm, and 3) access to accurate, timely, and consistent information is critical to running the business. The projected systems environment encompasses a shared corporate information architecture and enterprisewide, horizontally integrated systems that can be easily changed. The projected development environment is based on an integrated CASE tool that will produce these integrated, flexible systems and facilitate the establishment of a shared corporate information environment.*

## PHASE 2: MANAGING THE TRANSITION

While the IS directors we interviewed described similar scenarios for the first three environments, their transition paths differed widely.

### The Transition Process

The transition process is the tactical implementation of the envisioned development environment. Taking into account the unique critical factors in its current environment, each organization selected the *specific* tools and methods to be installed in the short and medium

term in order to migrate toward the projected development environment. Each of the three companies we have discussed chose a different initial path.

- ***The Insurance Company.*** *The new senior IS executive inherited an environment that necessitated a relatively slow transition process. While his ultimate goal is to have an integrated CASE environment, he has decided that purchasing an integrated CASE tool would be too big a change for his IS organization. Instead, he is taking a gradual, step-by-step approach, first purchasing a code generator, then purchasing an analysis tool, and so on. He is also investing in education and training in order to slowly change the culture and upgrade skills.*

- ***The Chemical Firm.*** *With its current emphasis on empowerment of individuals, the transition at this firm emphasizes the provision of relational information databases and other tools for the information support systems and the use of standard packages worldwide for the transaction systems. At the same time, significant time, effort, and dollars are being invested to change the IS organization in terms of both structure and individual attitudes about roles and responsibilities. These changes are being enacted as quickly as possible in this very large IS organization.*

- ***The Energy Company.*** *This firm is making the fastest transition: management purchased an integrated CASE tool and established a user information environment. At the same time, it made major investments to change certain aspects of its structure, management processes, and system infrastructure. Significant time, dollars, and effort have been spent to reorganize, retrain, and educate the IS group in order to change the skills and perspectives of IS personnel. Only with senior management's full understanding and strong backing could this transition process be carried out so quickly.*

These organizations anchored their transition decisions in the context of both their future and current environments. The former is especially important. Without this longer-term, business-based context, the real benefits associated with these often expensive choices would not have been clear. Without this clarity, business executives in our study sites would have understood only the cost side of the equation without the corresponding benefits.

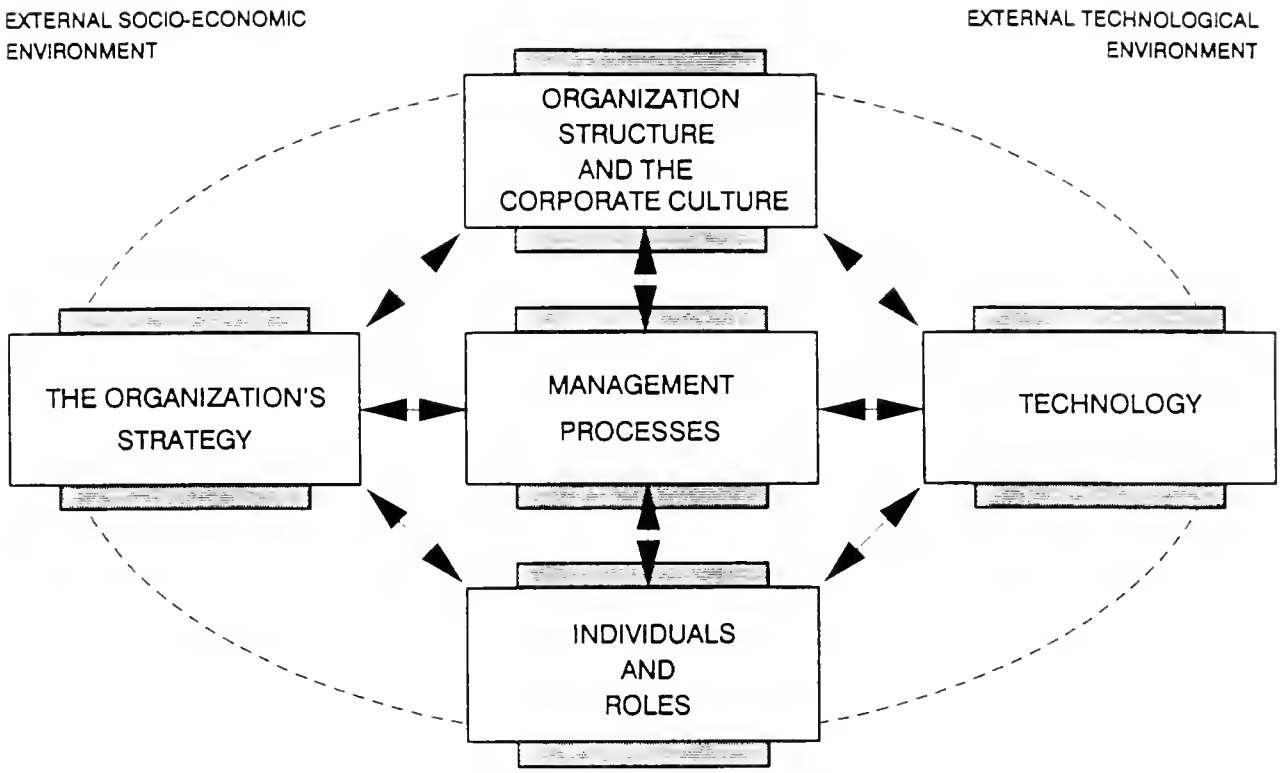
Whereas the projected environment indicates what *should* be done, the current environment dictates what *can* be done. In choosing the particular combination of IS approaches, techniques, and tools to be used, our interviewees, either explicitly or implicitly,

considered a clear set of components in developing their transition plans. In this section, we will discuss these components, the way in which they interact, and the ways they influence the choices to be made in defining the transition process.

Rockart and Scott Morton, drawing on Leavitt, describe a conceptual model of five organizational components that *must be kept in balance* when introducing a change into an organization: technology, corporate strategy, organizational structure, managerial processes, and individuals and their roles [Rockart and Scott Morton, 1984; Scott Morton, 1991; Leavitt, 1965]. The basic idea is that changes in one aspect must be balanced by changes in other aspects for the organization to remain effective. For example, a strategy change may necessitate changes in organization structure, technologies, jobs. Rockart and Scott Morton use the model to discuss the organizational changes that are necessary to successfully introduce technology-related change into an organization. Figure 2 shows this model, adapted to describe the changes necessary to successfully introduce technology changes into the IS organization. Although the focus here is on the components within the IS organization, it is important to also consider the parallel components at the company level. The components are as follows:

- ***Tools and Methods.*** These are the processes used to create systems -- systems development methods, tools, techniques, standards, project management processes, and measurement processes.

- ***Systems Infrastructure.*** This includes data, applications, and the underlying technology, that is, the hardware, system software, and network. The organization needs to evaluate the status of the current infrastructure, the extent of changes necessary, and the steps required to make the changes. This is a key area for consideration: a significant portion of the transition process involves migrating what for most organizations is a massive base of existing technology, data, and systems -- often stand-alone, function-specific, data-redundant systems




**Leavitt's Balancing Act (adjusted)**

*Figure 2*

-- into the new development environment, and integrating these previously disparate solutions to support the new interdependent organization.

- ***IS Organization Structure.*** IS organizations have unique structural patterns. One dimension (centralization versus decentralization) places analysts and programmers either close to or remote from their "customers." Change may be appropriate in this organizational arrangement. Another dimension, the degree of specialization within IS, may be forced to change as new development tools and procedures are introduced. For example, as code generators become more sophisticated, there will be less need for the specialized, technical function of "programmer," and greater need for a more business-oriented function of "analyst."

- ***IS Management Processes.*** These are the procedures that guide daily operation. Some of the most important are short- and long-term planning, formal and informal incentive and reward systems, and management of external relationships (including vendors, customers/users, etc.). Some are easy to change; others are more deeply entrenched.

- ***Individuals and Roles.*** This component includes people and their skills, roles, and responsibilities. Also included here are issues of training, education, and relationship building, which may need to be changed with the addition of a new development tool. As can be seen in Figure 2, there are three segments, or sub-components, all of which influence the decisions to be made. These are IS, senior management, and line/business.

  *IS.* Clearly, individuals in the IS organization -- analysts, programmers, managers, and so on -- and their skills, roles, and responsibilities must be reconsidered. Changes in the development environment require changes in IS skills, both in technical areas and in general business areas, such as communication and negotiation. It is important also to note that assigning new roles and responsibilities is not enough; it is critical to also change the

*assumptions* that people hold about those roles and responsibilities [Gash and Orlikowski, 1991].

***Senior Management.*** Development choices are affected by how well senior managers understand the process, as well as by senior management's priorities and the company's financial constraints. If senior managers are fully committed to the necessary changes, the IS executive may be able to implement greater changes in a shorter period of time than if senior managers simply recognize -- or do not recognize at all -- that change is necessary. A lower level of understanding also requires a greater investment in education by IS management.

***Line/Business.*** Similarly, how well other managers understand the process is also relevant. Certain changes in the development environment directly affect functional managers and others who must rely on the new systems.[8] The level of understanding these managers need depends on the degree to which they are affected by, and need to be involved in, the change. In turn, as is the case with senior management, their current level of understanding directly affects the amount and speed of change that can be made [Orlikowski, 1991].

- ***IS Development Strategy.*** This is the conceptual approach to how all of the other components will be configured to carry out the systems development process. With a major change in the development process, the strategy must include not only *what* will be done, but *how* the other components will be brought up to speed through education, purchase of tools, change in processes, and so forth.

---

[8] For example, because cross-functional systems by definition have multiple user groups, developing them effectively requires a very different project management structure than would be typical for the development of a function-specific system.

- ***Culture.*** Schein defines culture as the "basic assumptions and beliefs shared by members of an organization" [Schein, 1985]. It relies on, and is built from, the policies, procedures, and methods that are associated with "the way things have been done" in all the components of the diagram. Therefore, culture arises from and pervades all the other components. The traditional IS culture with its heavy technical orientation clearly is not appropriate for the organization and types of systems required in the 1990s. As stated earlier, changing the assumptions which underlie each component of this model -- particularly where the status of a component has been relatively stable for a long while -- can be very difficult. Schein believes that major culture shifts can only be accomplished through extremely effective, almost charismatic, leadership or by changing the key personnel involved.

- ***Technology Capability.*** Clearly, an important factor in choosing IS tools is the current and expected capabilities of these tools. Equally important is the systems environment (e.g., mainframe-centered or client-server) that is expected to prevail in the organization. For example, one organization did not purchase integrated CASE tools because current CASE technology did not support its emerging client-server environment.

It should be noted that the above components represent a composite picture; all factors were not mentioned by each interviewee. However, all are important. One cannot install a new development process without the appropriate balance of IS personnel skills, technical infrastructure, senior management understanding, and so on. The problem of a lack of balance in upgrading an organization has been dramatically illustrated in the automobile industry [McKersie and Walton, 1991]. In some plants, huge investments have been made in production line technology. However, the lack of equivalent investments in education and training of plant employees has made these investments ineffective and costly. The key question for IS management is: given the current status of all the existing components, how much can each component be changed, while maintaining the necessary balance? And, therefore, what should the transition plan look like?

To develop the transition plan, the IS executive must first evaluate the *current status* of the organization in terms of these components. Second, the IS executive must consider and address the *interaction and necessary changes in each of these components* for any proposed change in development tools to be successful. A change in one component will likely necessitate action in others in order to keep them in balance. Magnitude is another important factor -- a change that represents a major shift from current practice will affect a greater number of components and *will affect each one to a greater degree*. In considering a major change to the systems development process, the IS executive must determine whether the necessary financial and human resources exist to reach the stated objectives.

## CONCLUSION

Understanding and implementing a major change is complex and often nonlinear. The neatness of the cases and the process presented here is perhaps misleading. In fact, some of the IS executives we interviewed first visualized the systems and development environments and then urged senior management to think through the business environment as a means to facilitate the senior managers' understanding of, and support for, the required investment. In almost all cases, however, managers paid attention to all of the steps in both phases.

In closing, we believe five points are worth emphasizing. They are as follows:

***The Change is Critical.*** In most of the companies we visited, the similarity in projected business, systems and development environments was striking. If the IS organization is to keep up with the business's future needs, a new systems development approach is absolutely necessary. The question is not *whether*, but *when* and *how*.

***The Choices are Strategic.*** Too often organizations discuss the issues in this paper at an operational level. It has become increasingly clear that decisions regarding systems delivery mechanisms are strategic in nature, are major, and must be addressed by senior

management. Moreover, significant time and energy must be spent planning and executing the transition process and the necessary "balancing" investments in education, training, new methods, and so forth.

***The Change is Ongoing.*** It is important to recognize that the three future environments depicted in the framework will not -- and should not -- be defined and then frozen. The future environments represent strategic intent and should continue to evolve as realities change. The ability to accommodate and manage such uncertainty requires a change in people's assumptions and mental models about change. *This is not an event; this is a process.*

***Context Determines the "Portfolio of Solutions."*** Returning for a moment to our original scenario: who is right, the vice president of information systems arguing for CASE tools or the SBU manager arguing for packages? The answer is neither. Neither CASE tools nor packages by themselves will provide *the* answer to any organization's total set of needs. Rather, each organization must (1) design a *combination* of delivery mechanisms that will serve its particular needs and then (2) reposition the organization to achieve excellence in delivery. The combination must depend on the organization's envisioned future and on its current capabilities. What *is* wrong is the selection of a particular path without the type of careful analysis suggested by our framework.

***This is a Major Business Process Redesign.*** The key business process of the IS organization is the systems development process. Changing the way systems are delivered, therefore, is a major "business process redesign." IS often helps other functions redesign their business practices, placing special emphasis on helping them to meet future as well as current needs and to redesign the associated roles, processes, and structures. If the cobbler's children are not to be without shoes, the same thinking must be brought to bear on the redesign of the systems development process.

## REFERENCES


Davenport, T.H. and Short, J.E. "The New Industrial Engineering: Information Technology and Business Process Redesign," *Sloan Management Review* (31:4), Summer 1990, pp. 11-27.

Gash, D.C. and Orlikowski, W.J. "Changing Frames: Towards an Understanding of Information Technology and Organizational Change," *The Academy of Management Best Papers Proceedings*, Academy of Management, Miami, August 1991.

Hamel, G. and Prahalad, C.K. "Strategic Intent," *Harvard Business Review* (67:3), May-June 1989, pp. 63-76.

Hammer, M. "Reengineering Work: Don't Automate, Obliterate," *Harvard Business Review* (68:4), July-August 1990, pp. 104-114.

Henderson, J. and Venkatraman, N. "Strategic Alignment: A Model for Organizational Transformation Via Information Technology," Center for Information Systems Research Working Paper No. 217, Massachusetts Institute of Technology, Cambridge, MA, November 1990.

Kemerer, C.F. "Reliability of Function Points Measurement: A Field Experiment," Center for Information Systems Research Working Paper No. 216, Massachusetts Institute of Technology, Cambridge, MA, October 1990.

Leavitt, H.J. "Applied Organizational Change In Industry," *Handbook of Organizations*, Rand McNally, Chicago, IL, 1965, chapter 27.

McKersie, R.B. and Walton, R.E. "Organizational Change," *The Corporation of the 1990s: Information Technology and Organizational Transformation*, ed. Scott Morton, M.S., Oxford University Press, NY, 1991, chapter 9, pp. 244-277.

Orlikowski, W.J. "Radical and Incremental Innovations in Systems Development: An Empirical Investigation of CASE Tools," Center for Information Systems Research Working Paper No. 221, Massachusetts Institute of Technology, Cambridge, MA, April 1991.

Rockart, J.F., and Scott Morton, M.S. "Implications of Changes in Information Technology for Corporate Strategy," *Interfaces* (14:1), January-February 1984, pp. 84-95.

Rockart, J.F., and Short, J.E. "IT in the 1990s: Managing Organizational Interdependence," *Sloan Management Review* (30:2), Winter 1989, pp. 7-17.

Schein, E.H. *Organizational Culture and Leadership*, Jossey-Bass, San Francisco, CA, 1985.

Scott Morton, M.S. (ed.) *The Corporation of the 1990s: Information Technology and Organizational Transformation*, Oxford University Press, NY, 1991.